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A MONISTIC THEORY OF MIND.

I DO not understand the term *monistic* to imply a single process, but only a single principle. While mind may be explained as the result of one universal law there are several ways or modes in which that law operates. The unitary principle through which mind has been brought about may be comprehended under the general term *organisation*, but there are two very distinct modes or forms of organisation. One of these is the organisation of molecules to secure a greater effect from their combined activities, and may be called *chemical organisation*. The other is the organisation of biological units or cells into living organisms of higher orders, and may be called *biotic organisation*.

CHEMICAL ORGANISATION.

If the existence of matter be admitted it is scarcely more than an observed fact that all matter is at all times in a state of motion, while the law of the conservation of energy is nothing more than the inductive proof that the rate of motion of matter is fixed and unalterable, so that all attempts to constrain it merely alter the mode of its manifestation. Matter is only known by its effects which are due to its motions, and all differences in these effects are the result of such different modes of its motion, due in turn to some constraining influence. It is a known fact that under certain conditions, such, for example, as generally prevail on the earth, this power of matter to make itself known is increased in a great variety of ways through chemical organisation. This takes place through some form of union among its elements, concentrating and directing their activities in such a manner as to render them effective in producing results, especially in appealing to the senses of sentient beings.

The products of such unions of the elements of matter are what are known as *substances*, and the modes by which different substances produce effects constitute their *properties*. The monistic theory of mind contemplates it as a property of a substance, not as itself a substance. For the law that the properties of substances are due to their molecular constitution holds for all substances whatever, no matter how low or how high in the degree of organisation, or whether the organisation be chiefly chemical or largely biotic. It holds therefore for organised beings, and the properties these possess, including life and sense, are as much due to the way in which the material elements composing them are combined as are those of the simplest mineral substances. The phenomena of mind stand in the same relation to the brain and nervous system that all other phenomena stand to the substances that manifest them—in a word, mind is a property of the organised body. The body, organised as it is, with its nervous system and great central ganglion, manifests the properties which it possesses by virtue of its constitution in precisely the same way that all other substances manifest the properties resulting from their inherent constitution.

If we exclude the universal ether all known substances fall under three general heads, viz., chemical elements, inorganic compounds, and organic compounds. For these I have, on a former occasion,* proposed the following cosmical definitions.

"*Chemical Elements.*—Substances whose molecules are composed either of those of other chemical elements of less atomic weight, or of such as are too low to be capable of molar aggregation, and therefore imperceptible to sense; formed during the progress of development of star-systems at temperatures higher than can be artificially produced, and hence too stable to be artificially dissociated.

"*Inorganic Compounds.*—Substances whose molecules are composed of those of chemical elements or of other inorganic compounds of lower degrees of aggregation ; formed in the later stages of the

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**Popular Science Monthly*, Vol. XVIII, New York, February, 1881, p. 539.

development of planets at high but artificially producible temperatures, and therefore capable of artificial decomposition, and constituting the greater part of the solid crust of cooled-off bodies, their liquid, and a portion of their gaseous envelope.

"*Organic Compounds.*—Substances whose highly complex and very unstable molecules are composed of those of chemical elements, inorganic compounds, or organic compounds of lower organisation; formed on the cooled surfaces of fully developed planets at life-supporting temperatures."

Every substance differs from every other in both its constitution and its properties, and no chemist doubts that the properties of any substance are due to its peculiar nature or constitution. That is to say, the molecular constitution of a substance is the *cause* of the properties it manifests.

Now there is an important law, to which I long ago called attention,* governing the properties of substances. According to this law *the properties of substances are more active in proportion as their molecular constitution is more complex.* In our limited knowledge of what constitutes degrees of activity this is obvious only in the long run and many apparent exceptions may be pointed out. The properties of the simpler chemical elements are very inert, those of inorganic compounds are usually much less so, their activities increasing roughly with the degree of composition, and when the organic compounds are reached we find that many of them have very active properties. The law holds for the various grades of organic compounds as we pass from the less to the more complex. The vegetable alkaloids and organic bases that furnish most of the febrifuges, narcotics, and toxics, such as quinine, narcotine, strychnine, etc., are very complex substances and possess relatively large molecules into which carbon, hydrogen, nitrogen, and oxygen all enter.

Another important law of chemical organisation is that *increase in complexity is accompanied by decrease in stability.* It is now generally believed that the chief distinction between what are called the chemical elements, which were once supposed to be the ultimate units of matter, and the inorganic compounds, is that the former are so much more stable that it has been found impossible, by any means thus far devised, to separate them into any simpler components. Again, the distinction between organic and inorganic compounds has broken down all along the line through the artificial production of so many of the latter, formerly supposed to be formed only in the alembic of organic life. But it is here that we find the greatest instability.

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* "The Organic Compounds in their Relations to Life." *American Naturalist*, Vol. XVI, Philadelphia, December, 1882, pp. 968-979.

Not only is it difficult to judge of degrees of activity among the properties of substances, but it is certain that these differ widely in kind. The power to affect the senses and living tissues with greater or less violence is only one of the ways in which the properties of substances manifest themselves. There are other ways in which bodies, though wanting in this class of qualities, nevertheless give evidence of possessing much higher degrees of organisation. When we rise above the organic bases in the degree of chemical complexity, we encounter a group of which the molecules are relatively enormous, so large and complex, indeed, that it often becomes impossible to write their chemical formulas with any degree of certainty. These are the albuminous compounds, and albumen itself has been estimated to contain no less than 679 equivalents, which, reduced to the standard of the hydrogen atom, would make each molecule contain 4870 of these smallest-known chemical units. And now, agreeably to the law stated, we find that the substances of this group are characterised by correspondingly great instability. As a consequence of their exalted structure their molecular activities are far more extensive and varied than those of simpler bodies. One of the principal modes in which they manifest their activities is that which is called *isomerism*, whereby a substance, without any change in the nature or number of its molecules, but by some little-understood rearrangement of them, assumes a different aspect and becomes to all intents and purposes another substance.

There is still another important principle of chemical organisation which greatly aids us in comprehending these phenomena. It may be called the law of *recompounding*. It consists simply in using the simpler compounds in the formation of the more complex ones.

That is, these are not, or at least not necessarily, first decomposed into their simpler elements and afterwards combined to form the higher unit, but the units of lower orders enter bodily into the composition of the molecules of the higher ones. Without delaying to give examples at the earlier stages of development, we may pass at once to the albuminous compounds and suppose that albumen, with molecules five thousand times as large as those of hydrogen, is a compound of various forms of proteine, whose molecules are some four hundred times as large as the hydrogen atom, and that these proteine molecules remain undecomposed and combine to give to albumen the properties it possesses. In this way the progress in organisation gained in the development of the proteine molecule is not lost, but remains in full force as a factor in the properties of albumen. But we have reason to believe that from the hydrogen atom to the molecule of albumen the process of evolution has been uniformly the same, viz., that of compounding and recompounding, of doubly and multiply compounding; in short, it has been the process of molecular aggregation.

With still higher states of aggregation, therefore, we should naturally expect still higher forms of activity, still more marked properties. What properties ought we to expect in a substance formed by the recompounding of the albuminoids? No one could predict their nature. While it is safe to predict higher properties from higher degrees of aggregation, there is no basis whatever upon which to predict the character of these properties. We cannot even say which of the three states of matter, the gaseous, the liquid, or the solid, the new compound will exhibit at ordinary temperatures. The invincible solid, carbon, when joined with oxygen, becomes a gas; the type of gases, hydrogen, when combined with another gas, oxygen, results in water, which is a solid at 32° Fahr.; the inert gas, chlorine, combined with the equally inert liquid, mercury, forms corrosive sublimate, which has very active properties and in no way resembles either of its components. And so we might go through the entire list. The general truth is that chemical union results in a new substance with new properties, different from and of a higher order than those of any that have united to produce it.

When, therefore, the highest known chemical compounds still further combine, we ought to look for something new and important. When the largest molecules whose constitution can be determined in the laboratory form themselves into higher molecular systems, we should not be surprised if the resultant substance should be an exceedingly remarkable one. The activities of all substances up to this point are molecular, but it might well be that the new compound should possess *molar* activities. At all antecedent stages of chemical organisation the spontaneous activity is confined to molecules; at this new and higher stage these spontaneous activities may be able to break over these bounds and manifest themselves in the mass.

Now we have a substance—its name is *protoplasm*—suspected of having the origin indicated, which is capable of such spontaneous movement as a mass. This wonderful property, confined exclusively to this substance, has been given the briefer name *motility*. This astonishing substance, protoplasm, whose existence was not suspected at the beginning of the nineteenth century, is now known to be an abundant product of nature, to be present in every living thing and in every part of all organic beings, if such part is really alive. It is this which makes it alive. Professor Huxley has happily called it "the physical basis of life." Not animals alone, but plants as well, have protoplasm in every living cell, and it is as active in the one as in the other.

But bound up with this principle of life, and almost as a part of it, protoplasm possesses another, and, if possible, still higher property. This property may be fittingly called *awareness*. The activities of protoplasm are not sporadic and meaningless, but systematic and purposeful. Protoplasmic bodies recognise differences in their environment. As Major Powell, in his new psychologic terminology, would probably say, they have a "knowledge of good and evil." In a word, they feel. The misnamed "pseudopodia," which they send out are really improvised antennæ or "feelers," which they employ in exploring their surroundings. Protoplasm is therefore not merely the physical basis of life, it is the physical basis of mind as well, and all nerve tissue that is essentially such consists of protoplasm in some of its myriad forms. From the strictly material side, protoplasm is the essential thing in life, and it is also the essential thing in mind. There is no other element controlling either vital or psychic phenomena. When this stage of chemical organisation was reached, evolution ceased along this line. The new line of subsequent development has been that of biotic organisation, and plants and animals may be regarded simply as mechanisms for the concentration, focalisation, and intensification of the inherent powers and properties of protoplasm.

BIOTIC ORGANISATION.

Molecular aggregation or chemical organisation could not in the nature of things go farther than the production of protoplasm. This substance already oversteps the limits of molecular activity and trenches on the domain of molar motion. If matter is to produce any wider effects it must be through the organisation of protoplasmic bodies. Biology teaches us how it does this. The biological unit is the cell whose activities are determined by the protoplasm it contains. There are organisms consisting of a single cell—unicellular organisms. Then, as a first step, a group or company of these become feebly bound together so that nutrition passes from the one to the other. Such a group is called a *cœnobium.* These exhibit various gradations, and at length there are formed permanent colonies, such as polyps and sponges exhibit. Plants may be placed in this class, a tree consisting of a vast assemblage of permanently associated individuals. By an indefinite number of further steps this process of integration is carried up until the true Metazoa are reached.

But, as we saw that even protoplasm acquired the quality of awareness, so the organised states of protoplasm acquired correspondingly increased degrees of this sentient property, and *pari passu* with the development of life, there went on a development of mind. To this end a nervous system was acquired by all the higher animals, and from a series of coördinate ganglia with feeble connexions there grew up a supreme ganglion with all the subordinate ganglia completely under its control. And with still higher organisation there took place a process of cephalisation, whereby, with increase of brain, there was constant increase in the mind-element or psychic property. When at length mammalian life was reached a highly developed brain had been evolved.

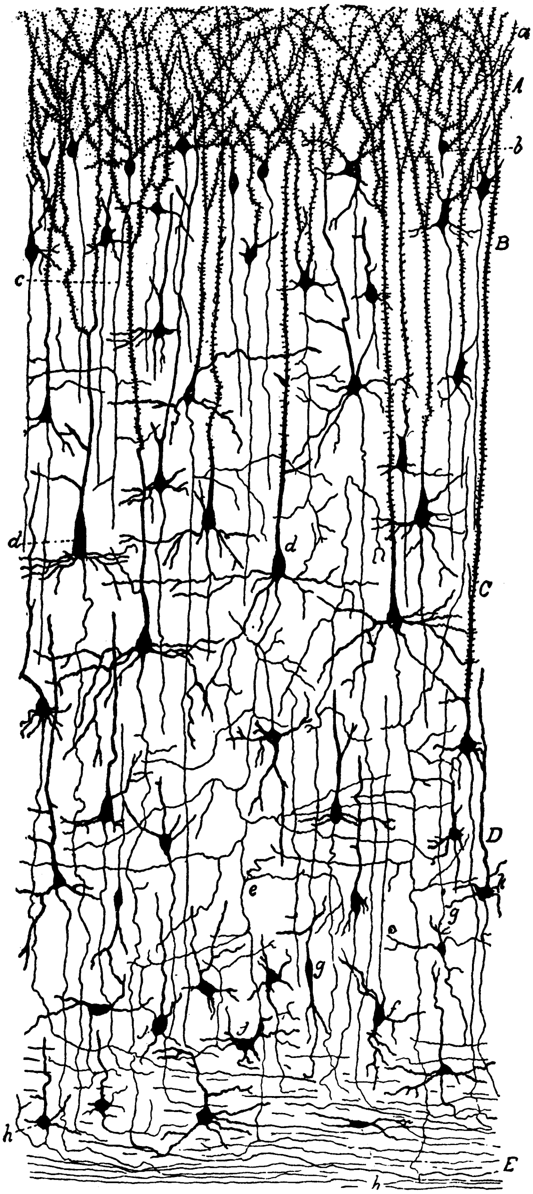

Fig. 1.—Section of the cerebral cortex (Ramón y Cajal). From the supra-ventricular region of a young mouse. A. Molecular layer. B. Small pyramidal layers. C. Large pyramidal layer. D. Layer of irregular corpuscles. E. White matter. *a*, panicles of the pyramids; *b*, smallest and most superficial of the pyramids; *c*, axis-cylinder from a small pyramid; *d*, large pyramid; *e*, its axis-cylinder; *f*, cell with ascending axis-cylinder; *g*, similar but smaller cells; *h*, cells found in the white matter; *i*, rounded cell that sends its axis-cylinder toward the white substance; *j*, cell with short axis-cylinder process.

Progress in the discovery of the true nature of the brain and nervous system has been very slow and is almost exclusively confined to the last half of the present century. This was chiefly due to the want of effective methods of study. As such methods were gradually invented and introduced by Stilling, Deiters, Remak, Clarke, Müller, Gerlach, Waldeyer, Schulze, Golgi, and others, fresh light was thrown upon the whole subject, but it is only within the last few years and chiefly through the labors of His, Lenhossék, Obersteiner, Gehuchten, and Ramón y Cajal that those important advances have been made which place it upon a firm scientific footing. To Dr. Frank Baker, Curator of Comparative Anatomy in the United States National Museum and Manager of the National Zoological Park, is due the great credit of having laid before the readers of English an able and exhaustive review of the history of this important field of investigation. This paper, which cannot be too highly commended and which all should read, appeared in the *New York Medical Journal* for June 17 and 24, 1893. The accompanying figure (Fig. 1), which Dr. Baker has reproduced with slight modifications from an important memoir by Ramón y Cajal,* exhibits a section through the cortex of the cerebrum, regarded by most physiologists as the principal organ of consciousness and of mind in general. The little knots with irregularly radiating fibres proceeding from them in various directions, are the corpuscles of the brain, or brain-cells, which are scattered, not wholly without order, through the general mass from the surface of the convolutions above to the white matter below. The existence of these cells has long been known, but the nature of the thread-like processes which proceed from them has only recently been discovered. Not being an anatomist myself, and yet wishing to be altogether correct on such an important point, I shall here make use of Dr. Baker's own language: †

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* *Sur la Structure de l'Ecorce Cérébrale de quelques Mammifères*, par S. Ramón y Cajal. *La Cellule*, Vol. VII, Bruxelles, 1893, pp. 123–176, 3 plates; pl. ii, fig. 7.

† See the article mentioned above, *New York Medical Journal*, Vol, LVII, June 24, 1893, p. 685.

"It has long been known that a considerable portion of the cortex is occupied by large cells of a triangular outline, presenting a pointed extremity toward the exterior. These, the pyramidal cells of authors, are of great size in the so-called motor regions of the cortex—that is to say, in the central convolutions. . . . These structures have wide-reaching connexions, and Ramón y Cajal and Van Gehuchten have much extended our knowledge. . . . It has been noted that there appears to be a direct proportion between the size of a nerve cell and the number and length of its processes. This is justified in the present instance, for there proceed from these cells highly complicated processes, some of them of great length. From the apex of the cell a protoplasmic stem passes up through the superficial layers of the cortex and terminates in an arched arborescent panicle, each composed of plume-like expansions barbed with secondary spines. These panicles interlace with each other throughout the superficial layer of the cortex in the most intricate manner, forming a perfect forest of branches which, however, never anastomose with each other. . . . Besides the extraordinary appearance and peculiar situation of these cells there are reasons drawn from embryology and from comparative anatomy that indicate the probability that they are the chief agents in the psychic activity of the cortex. As we ascend the scale from the lower vertebrates to man, an increasing complexity of structure is found in these cells, and there is also seen a similar progressive development when the different stages of their growth in the embryo are observed. Ramón y Cajal has therefore given to these structures the name of *psychic* cells." *

As Dr. Baker intimates, the Spanish investigator lays it down as a general principle that the farther back we go in the ontogeny of the brain of mammals, that is, the younger the specimen is that is being studied, the fewer and shorter become the protoplasmic expansions, and that the same is true of their phylogeny, that is, as we descend in the scale of organisation. The following additional figure (Fig. 2)from the same sources will make this clear:

It is probable that the failure to make these important discoveries before is largely due to the fact that early investigators confined their attention chiefly to the brain of man or of the most highly developed animals and these at adult stages, in which the processes were much too long to be either successfully traced to their ultimate terminations or brought within the field of the microscope. And I may say that Fig. 1 represents a portion of the brain of a mouse at the age of one month. If it requires such a complicated brain structure to conduct the simple psychic activities of so humble a creature, what must be the structure required to conduct the psychic activities of a Newton or a Spencer!

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* "Tal es la disposicion de la célula piramidal de los mamiferos, de la que podríamos llamar, invocando su especial morfología y su exclusivo yacimiento en la corteza cerebral, *substractum* de los mas elevados actividades nerviosas, *célula psiquica*."—*Nuevo Concepto de la Histología de los Centros Nerviosos.* Por el Dr. D. Santiago Ramón y Cajal. Conferencias pronunciadas en la Academia y Laboratorio de Ciencias Médicas de Cataluña en los días 14, 18, y 19 de Marzo de 1892. Publicadas en la *Revista de Ciencias Médicas de Barcelona*, nums. 16, 20, 22, y 23, de 1892. Tomo XVIII, Barcelona, 1893, p. 27.

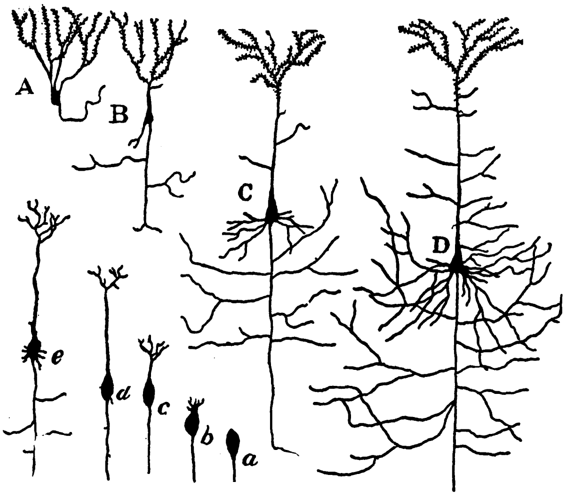

Fig. 2.—Phylogeny and ontogeny of the psychic cells (Ramón y Cajal). The upper series of cells shows the psychic cells shows the psychic cell in different vertebrates. A. Frog. B. Newt. C. Mouse. D. Man. The lower series shows the stages of growth that a single cell passes through. *a*, neuroblast with axis-cylinder process just commencing; *b*, panicle commencing; *c*, panicle and axis-cylinder process more advanced; *d*, collaterals of axis-cylinder appearing; *e*, collaterals of the cell body appearing.

Says Ramon y Cajal:

> "As a final synthesis it may be affirmed that the human brain owes in great part the superiority of its activity, not only to the considerable number of its elements, but especially to the extraordinary richness of its means of association, that is, to the collateral branches of the axis-cylinders, the protoplasmic ramifications etc." *

It will thus be perceived that in all this we are dealing altogether and essentially with protoplasm and the mechanical means of enabling it to do the maximum work. Pyramidal cells, ascending processes, plumose panicles, axis-cylinders, and collaterals, all consist chiefly or wholly of protoplasm. Just as the essential thing in life is spontaneous movement, or motility, so the essential thing in mind is conscious sensibility, or awareness. These are the properties that distinguish protoplasm from all other substances, and upon these as foundations the body and mind, respectively, of all living things, including man, have been built up by the organising powers of nature.

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* *La Cellule*, Vol. VII, Bruxelles, 1893, p. 172.

COROLLARIES.

Two important corollaries flow from this monistic, and, as I must claim, only scientific theory of mind :

1. Conceived as a property, mind can present no greater "mystery" than that which is presented by any other property. If sensibility is, as it seems to be, only the necessary correlate or obverse side of motility, then the chief distinction between sentient and non-sentient bodies is that the activities of the former are partly molar instead of wholly molecular. No one can logically argue that spontaneous molar motion is essentially more mysterious than spontaneous molecular motion, yet no physicist or chemist any longer doubts that every atom and molecule of every substance, whether solid, liquid, gaseous, or ethereal, is in a state of ceaseless activity from an inherent motion of its own. This, however, though a known fact, is not regarded as a mystery. If the progress of development has been anything analogous to what I have outlined, if mind is a property of organised protoplasm, or if any such relation subsists between body and mind as subsists between other substances and their properties, then the question at once arises : Why not locate the "mystery" farther down in the scale, and cease to confine it to this one highest stage? For we are obliged to confess that the simplest qualities of matter are utterly inexplicable. We know just as much about why nerves feel and brain thinks as we do about why sugar is sweet or lead heavy. Even the simplest of all physical phenomena, those of gravitation, are utterly unknown to man except as observed facts and formulated laws. He is still as ignorant of why an apple

falls to the ground as he is of why and how he is able to see it do so. The attitude of awe and wonder before any of the phenomena of nature belongs to the childhood of the intellect and will be outgrown with its growth.

2. If mind is a property of body it is as inseparable from it as other properties are from the substances that possess them. It has no independent existence. In and of itself it is nothing. Like all attributes, it belongs to the category of relations, not to that of essences. The supreme fallacy of all philosophy has been that of treating mind as an entity.

It is, to say the least, curious, that it should fall to science to defend the immateriality of mind. It is still more paradoxical that it is this relational view of mind that is popularly looked upon as *materialistic.* If to posit a material basis for the phenomena of mind be materialism it were useless to attempt to evade the charge. But if the term materialism be employed in its only proper and legitimate sense as postulating the material nature of mind itself, the scientific conception of mind is the farthest remove possible from a materialistic conception. The antithesis between matter and property is absolute. Mere attributes are, in the clearest sense of the word, immaterial, and mind is simply an attribute. It would be as reasonable to insist that love, honesty, virtue, and liberty were material things as to say that feeling and thought are such.

If, on the other hand, we glance at the theory of mind that stands opposed to the scientific view, it is difficult to see how the charge of materialism can be escaped. If there is an element, call it mind, thought, soul, spirit, or what not, that can detach itself from the personality to which it normally belongs, and pass into another body, or remain in space performing mechanical operations upon material objects, it matters not whether it be visible or invisible, or whether it can appeal in any way directly to sense or not, such a thing possesses the nature of a material body, as much so as the invisible atmosphere, the rarer gases, or the vastly more tenuous ether that vibrates to so great purpose against the retina of the eye. Turn it as you will, twist it as you may, matter can only be affected by matter, and the impact of moving matter against other matter is, in the last analysis, the essence of force. And this is true of the method which mind itself employs. Thought and feeling, in and of themselves, are powerless, nay, they are *nil.* They can only act through a motor system which uniformly and necessarily accompanies the sensor system, which transfers molecular nerve-vibrations to the muscles, transforms them into muscular movements, and communicates them mechanically to the world without. It is this that we mean by the term *expression,* whether it be of emotions or of ideas.

This view of mind has all the promise of a true science. Mind is a great power in the world. It has wrought mighty changes in the past and is destined to work still mightier ones in the future. An experimental psychology will place the laws of mind more and more within the grasp of man, even as experimental physics and chemistry have placed the laws of matter within his power. The opposite or ontological view, which I have shown to be essentially materialistic, merely represents the alchemy of mind. The self-styled "psychical researchers" are simply searching for the philosopher's stone. The same class have always been seeking it, and until late in the present century the whole domain of mind was in the pre-Baconian and mediæval stage. The baser metals of mind will be transformed into gold by the new science of psychology in the same way that those of matter were transformed by chemistry, and if the race of psychic alchemists, who imagine that gold alone has value, are disappointed with the result, the rest of the world will rejoice as it always rejoices when science triumphs over magic.

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